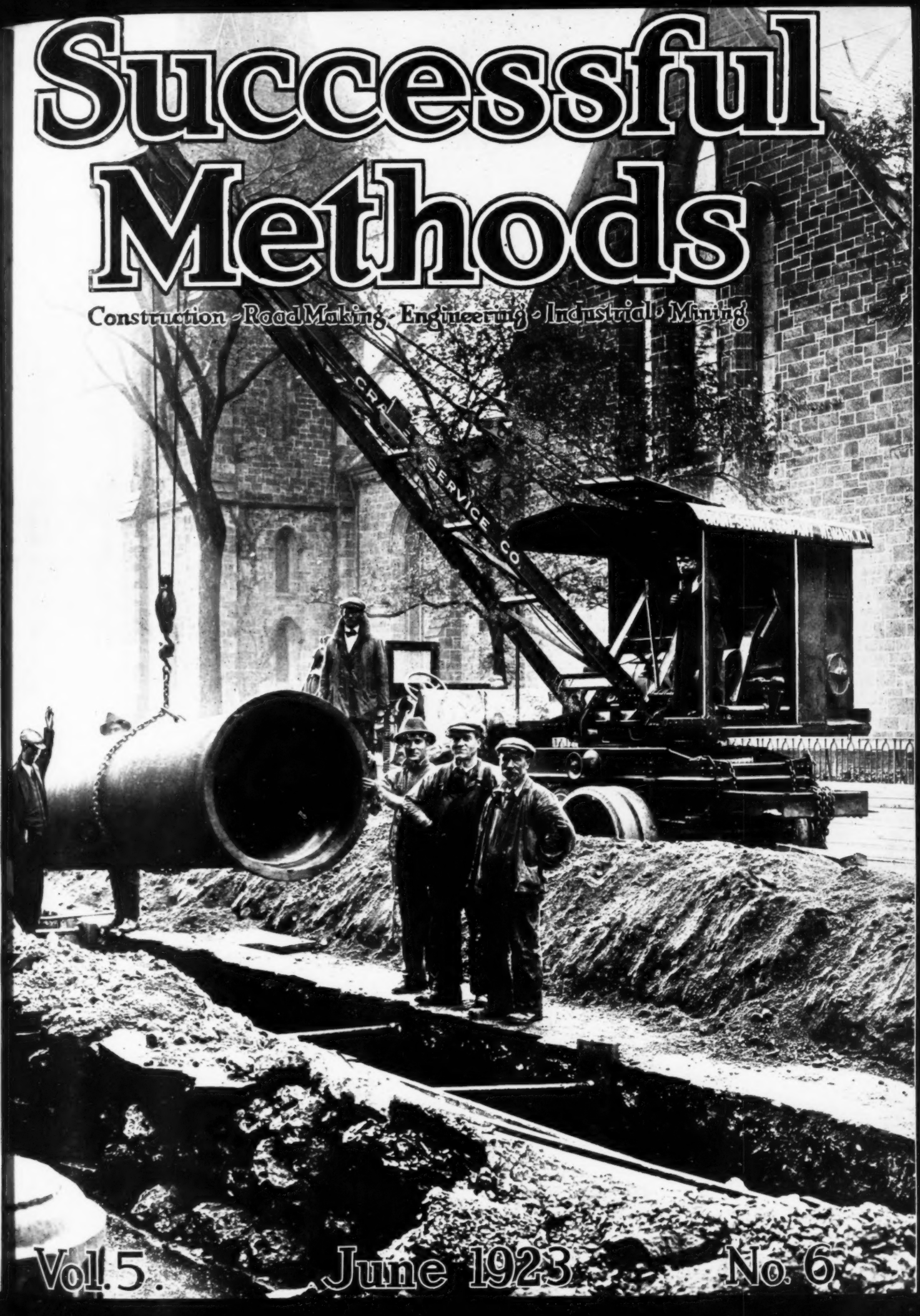
Successful Methods

Construction - Road Making - Engineering - Industrial - Mining



Vol. 5. June 1923 No. 6

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Successful Methods

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Building Up a Stock Pile

ACCORDING to the daily newspapers, construction work has slowed down in all the Eastern States. Some newspapers have tried to prove that there is a "buyers' strike" in the construction industry of the whole country. In their usual desire to make a bigger story, they have played up the situation until they have aroused a lot of unfounded fear of what might happen. Since most men allow their fears rather than their judgment to guide them in running their business, it seems worth while to stop to analyze the situation a moment.

There undoubtedly is a basis of fact for the newspaper reports that have appeared. Some reaction from the peak which was reached recently has occurred. Hardly enough has happened thus far, however, to be more than a healthy let-up. A runaway price and wage situation seems to have been avoided at least temporarily. Meanwhile most of the work that has been postponed will help wonderfully in spreading good times for the construction industry over several years.

Some state highway departments have announced that they will let no more contracts for new construction until there is in sight a surplus of materials and labor for work already under way. This general policy has been followed by various corporations which had planned to go ahead with big work this year. Hydro-electric projects that are greatly needed have particularly been delayed pending more favorable investment conditions. Much housing and small work has been set aside for similar reasons.

There are two outstanding features of this recent flurry. One is that the money is available for most of the projects that have been postponed. The other is that there is an urgent demand for these delayed improvements.

Both these conditions mean that most of the postponed work will be forced into the market within a year or less. In the meantime the normal increase in demand for improvements and extensions will occur. There thus is being created a very satisfactory stock pile of work on which the construction industry will be able to draw somewhat indefinitely. At the same time the let-up has prevented what might have been a very serious inflation in prices and wages due to a shortage of materials and men. It also has evidently saved a quick and serious drop which experience shows always follow such an inflation.

It Hardly Seems Possible

ABOUT this time last year there appeared in this column statements about the common labor shortage which were rather severely criticized. No attempt was made in these statements to pose as a prophet. Attention merely was called to the signs of what we are now into in the way of lack of men.

Without any fear of again being criticized, we are going to stress a situation in the construction industry that is a sad reflection on the judgment of many who are engaged in it. We have in mind the use of hand labor, at present wages and with the present shortage of men, on jobs which can be done quicker, cheaper and better by machines.

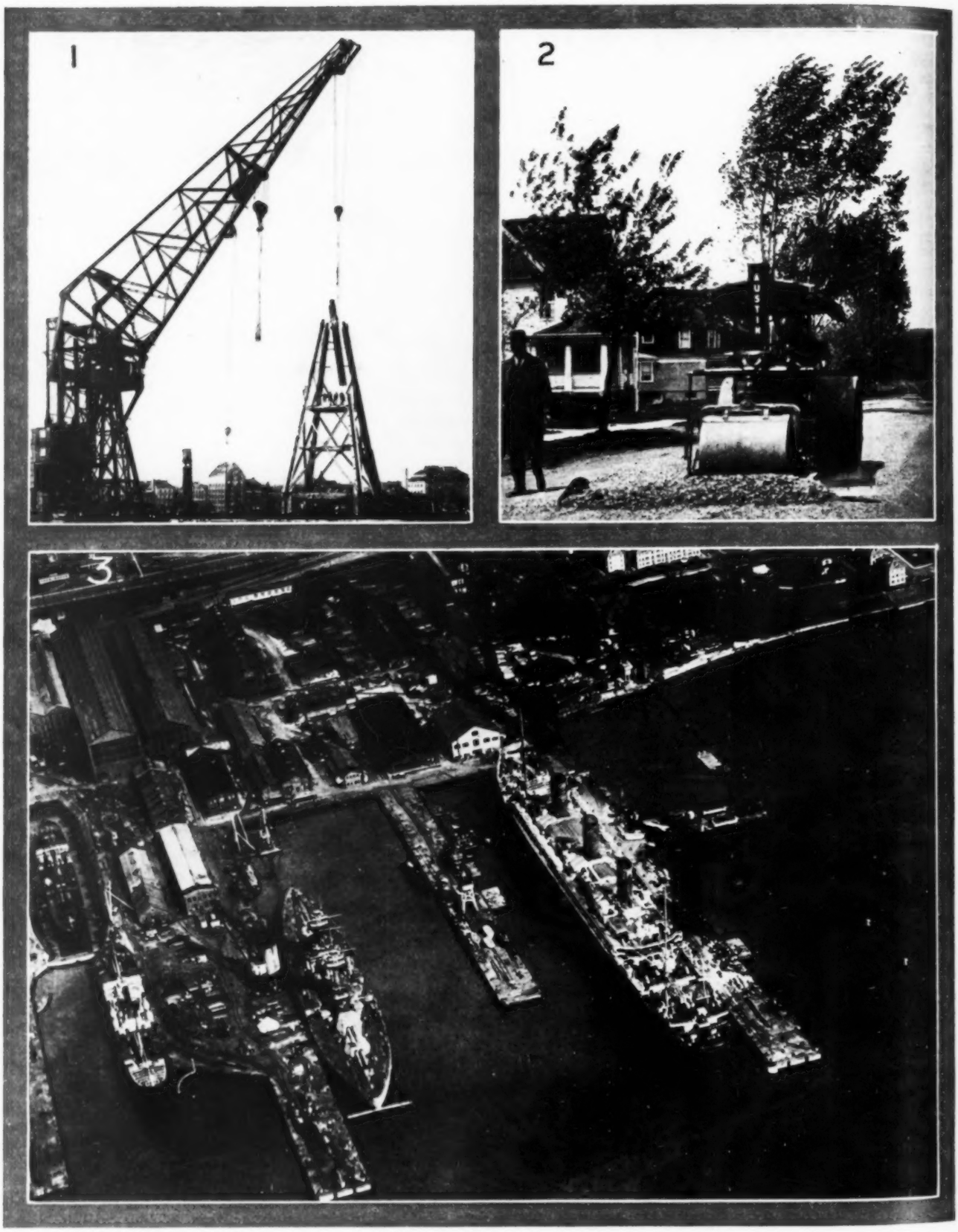
Take, for example, concrete mixing and handling. On an 18-ft. concrete road job that is under way in an Atlantic State, the contractor has no equipment except a mixer and a roller. He could get rid of at least twenty men by putting in two or three machines. He could buy these machines on easy terms. Even though his credit was not good enough to get terms, he could at least rent the machines at a big saving over his present costs.

This road job is by no means an exception. There are many road jobs over the country that have been planted on the basis of cheap and plentiful labor by men who apparently do not understand what labor-saving machinery can do. There also are various other kinds of work that are being just as seriously mismanaged from the same viewpoint.

A surprisingly large proportion of the construction men of the country seem slow to wake up to the fact that present wages make labor-saving machinery a good buy for the work they have always considered strictly hand-labor jobs. In many localities it is not merely high wages, but it is a case of getting labor at any price. And, still, most contractors simply keep bidding against each other for men, instead of putting in machines that will take the place of men. Sooner or later they are going to have to change their methods or go broke.

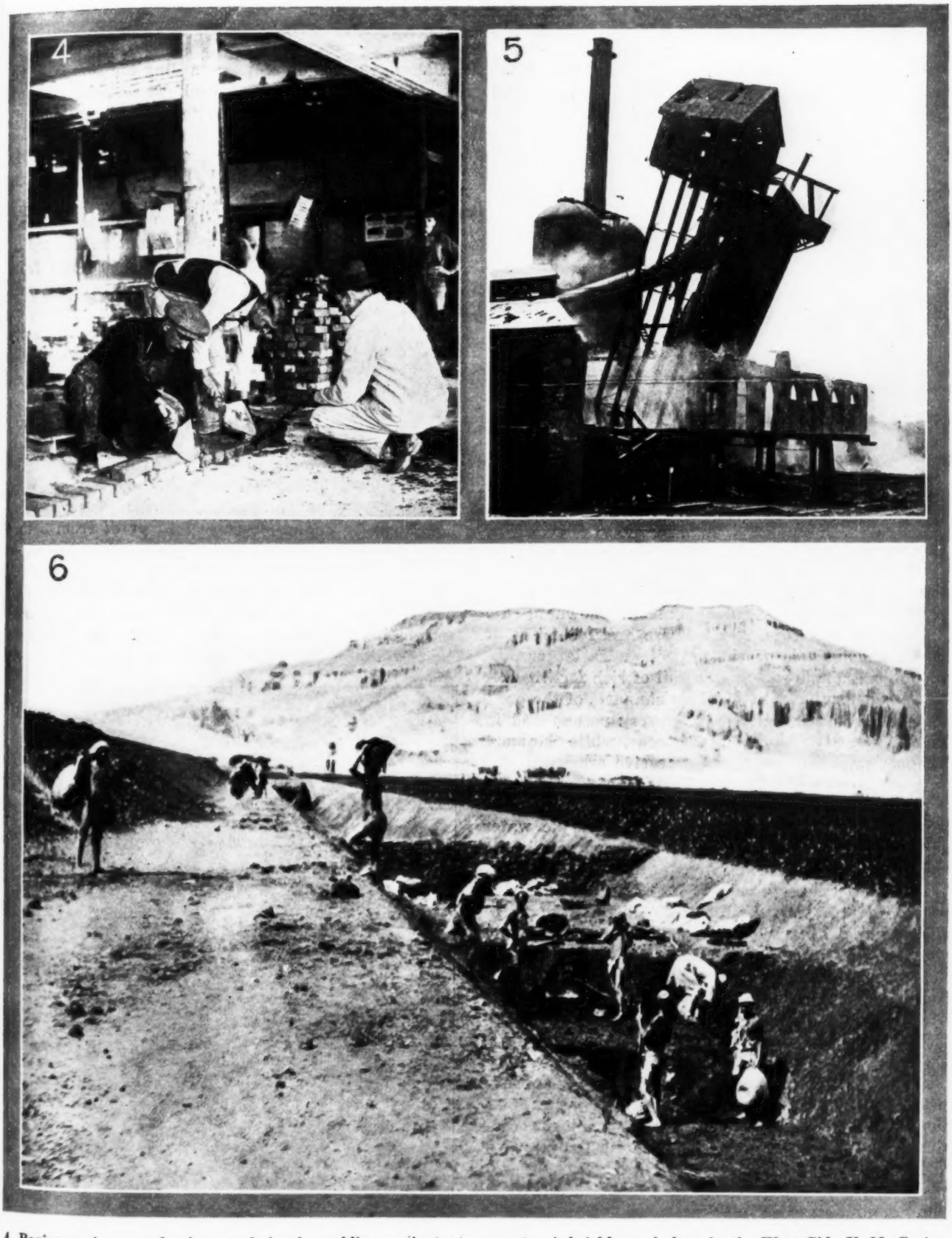
There will be a very slow change, however, in the attitude of construction men toward the use of more labor-saving machinery. They will squeal like a pig under a gate because wages keep going up and men keep getting scarcer. A few live wires always get the jump in a situation such as this. They will be the men who some way right off get the machines on the job that will solve their labor problems.

Variety Is the Rule



1. The Germans who built it claim that the crane shown in this photograph is the largest in the world. © *P. & A. Photos*
2. The smallest roller which is shown in this photograph is an American product. It weighs only 3 tons.
3. The end of a gigantic reconstruction job. The Leviathan, which has been reconditioned at a cost of $8,500,000, lying at her pier at Newport News. © *P. & A. Photos*

In Construction Field



4. Beginners in a profession much in the public eye just at present. A bricklayers' class in the West Side Y. M. C. A., New York City. © *International*
5. Getting rid of an old blast furnace in order to make room for a new one by quick and effective methods. Dynamite was used to destroy the old structure. © *P. & A. Photos*
6. Egyptian construction crew working with primitive methods in the Valley of the Nile. © *Keystone*

CONCRETE LINING ON ORLAND IRRIGATION PROJECT

Successfully Used in Reducing Maintenance Cost and Seepage Loss

By R. C. E. Weber, Project Manager
U. S. Reclamation Service

CONCRETE lining of 1½-in. thickness has been successfully placed and used on the Orland project, located in the northern portion of the Sacramento Valley, at Orland, Cal. The project, consisting of 20,500 acres, is one of the major projects constructed by the U. S. Reclamation Service under legislation of Congressional enactment, known as the National Reclamation Act. There are 148 miles of canals and laterals on the project and a larger proportion of them are located in soil of rich fertility. A large amount of the distributary channels of the project are located in soil which is very porous and in which excessive seepage losses occur, while the more compact soils are subject to excessive erosion.

FINISHING LINING WITH FINISHING TROWEL

It was apparent early in the history of the project's operation that in the interest of economy in maintenance costs and in the conservation of the water supply some comprehensive system of concrete lining would be essential. The first lining was placed in 1911. While the original plan of the project contemplated about 30 miles of lined sections, the results of the lining first placed, together with increasing maintenance costs and distribution losses, were instrumental in the project landowners during 1917 entering into a supplemental agreement with the Secretary of the Interior by which they contracted for an additional project construction charge of $11 per acre to be expended in placing concrete lining. The fund available from this supplemental charge is approximately $222,000 and work in connection with its expenditure was begun in 1918 and has been carried on during each winter season until at the present time there are 78.5 miles of concrete-lined sections on the project. The winter season lends itself admirably to the prosecution of lining operations and the work is confined to a period of six months from about Oct. 15 to April 15.

Data have been obtained regarding the comparative costs for maintaining concrete-lined sections and for unlined sections in earth. The unlined sections involve an expenditure of $53.70 per mile of lateral of average capacity, say 25 sec. ft., on the project. It costs $19.50 per mile to maintain the concrete-lined sections. Thus, it may be seen that an economy of $34.20 per mile or a reduction of nearly 65 per cent in the maintenance cost of earth sections results from the use of concrete lining. Additional factors in favor of the concrete-lined section are the increased degree of operating safety and the reduced seepage loss.

Most of the lining placed in the project has been machine mixed, probably 20 per cent placed prior to 1914, being hand mixed. The methods described in this article are those used in connection with the machine-mixed product.

Owing to frequent moves in connection with lining laterals, a mixer of from 3 to 4 cu. ft. capacity is best adapted to the work. Stakes at intervals of 15 ft. are provided for alignment and for grade of bottom of floor and top of lining, from which the section is prepared for placing the lining and to which the lining is placed and finished. The lateral is prepared by means

CONCRETE-LINED SECTION SOUTH CANAL

GENERAL VIEW OF CONCRETE-LINING OPERATIONS ON HIGH LINE CANAL

of mattocks, picks and square point shovels. A force of from 15 to 25 men is required to prepare the section in advance of the concrete crew, the variation depending upon the nature and hardness of the soil encountered together with the general shape and condition of the lateral. The concrete force consists of 5 men at the mixer, 4 to 7 wheelers and 4 men in the lateral, a maximum total of 16. Three men at the mixer are engaged in charging the hopper with gravel, cement and water, one in operating the machine and in regulating the discharge of the mixed concrete into a metal-lined chute, which conveys the concrete from the mixer on the bank to the wheelbarrows in the lateral, while the fifth man loads the wheelbarrows with the concrete in the chute. Three to seven men (depending on the length of wheel) are required to transport the concrete to the placers and finishers. End dump wheelbarrows are best adapted to the work. To facilitate transporting, 2 by 6-in. wheeling planks are provided. Two men are required to place the concrete on the slopes and floor while 2 are necessary for finishing. The maximum length of wheel is 300 ft., mixer set-ups being at 600-ft. intervals. A longer length of wheel is extremely irksome on the wheelers. There is also a tendency for a separation of the cement from the aggregate of the concrete in a length of wheel in excess of 300 ft. In addition to the foregoing force, a teamster with a 2-horse team is required for hauling water and moving mixer and equipment. Cement is hauled to the work from the project storehouse at Orland by means of a 1-ton truck and trailer, 15 barrels constituting the average load for both truck and trailer. A foreman is in direct field charge of the entire force.

Side slopes, when dry, are thoroughly sprinkled in advance of placing the lining. Lining is kept moist for 3 days following placing during weather when excessive drying occurs. Progress of the work is downstream which renders it possible to bring water, controlled by small earth dams, over the lining the day following placing, which facilitates keeping the concrete moist and affords easy accessibility to water necessary for mixing. A concrete of dry consistency is necessary for placing the lining on the side slope and the same degree of consistency is used for the floor as it is difficult to transport a wet mix in the end dump wheelbarrows without excessive spilling. Side slopes are placed first, followed by placing of the floor. Finishing of side slopes is first accomplished by means of the reverse side of a square point shovel while the final finishing operation is performed with a finishing trowel. For finishing the floor, the reverse side of a square point shovel is utilized for smoothing the junction of the side slope and bottom, while the intervening area is finished by means of a trowel, similar to that used for the side slopes, but of heavier construction.

Expansion joints are provided on the side slopes only and at 6-ft. intervals. After final finishing, the lining is cut by means of a pointing trowel guided by a straight edge and the surface of the joint thus created is finished with a sidewalk jointer. The lining is pierced to the full extent of its thickness by the joint thus made, which provides an artificial line of weakness in the concrete slab along which all future expansion and contraction occurs.

The mixture of the concrete used for lining is 1.7 and the lining averages 1½ in. in thickness. Lining

of this thickness placed in 1911 and in use since that date is in excellent condition at the present time, demonstrating the durability of this class of lining in the Orland vicinity where comparatively mild winters, with minimum temperatures of 21 deg. above zero prevail. Run-of-bank gravel from Stony Creek, which traverses the project centrally and other local creeks, is used for aggregate. Screening of the gravel is required only in rare instances where length of haul is excessive to gravel containing rock passing a 1-in. screen. The gravel as found in its natural state does not require washing for a satisfactory quality of concrete.

For the purpose of listing the various items of costs of concrete lining, the following tabulation of cost for lining placed during the calendar year 1922 is prepared:

Items of Cost	Total Cost	Cost per Sq. Yd.
Preparing slopes and bottom	$6,578	$0.071
Cement, including hauling to work	11,094	.121
Gravel	4,381	.048
Mixing	2,202	.024
Placing	3,778	.042
Finishing	454	.005
Sprinkling and protecting	120	.001
Water	373	.004
Repairs and supplies	797	.009
Equipment charge	415	.004
Total labor and material cost	$30,192	$0.329
Superintendence	$694	$0.008
Engineering	187	.002
General expense	3,443	.037
Total overhead cost	$4,324	$0.047
Total cost	34,516	$0.376

Quantities

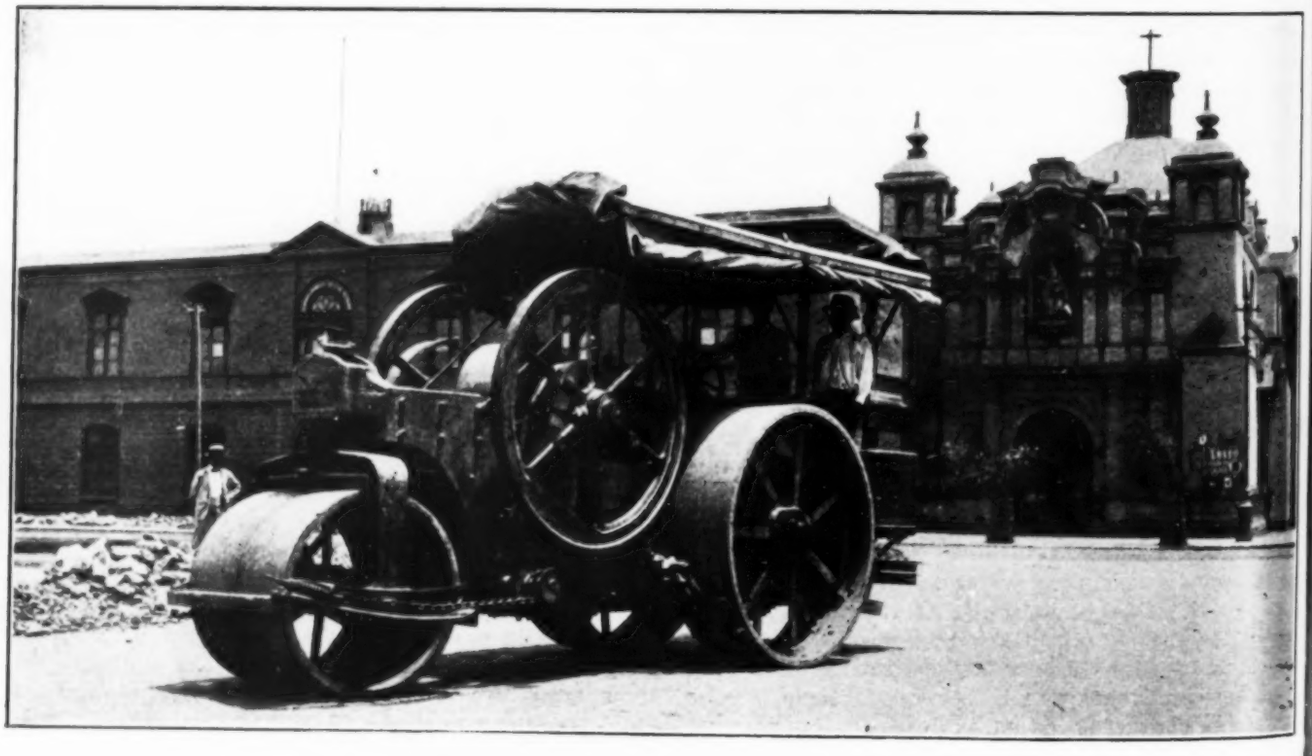
Items	Unit	Quantities	Cost Per Unit
Lining	Sq. Yd.	91,871	$0.376
Concrete	Cu. Yd.	3,163.7	10.91
Laterals lined	Miles	10.14	3,403.94
Laterals lined	Lin. Ft.	53,555	0.644

The average labor cost per day for the period covered by the foregoing table was as follows: Ordinary labor, $3; special labor, $3.50; placers, $4; finisher, $4.50; teamster with 2 horses, $5.50, and teamsters with 4 horses, $8. The cost of cement at the project warehouse was $2.86 per barrel. The average haul of gravel was 2 miles and for cement, 4 miles from project warehouse to the work. The capacity of the laterals lined varied from a minimum of 15 to a maximum of 75 sec. ft. The size of the sections were as follows: Bottom width, 3 to 16 ft.; vertical height, 1.7 to 4.8 ft.; side slopes, 1½:1 and 2:1.

Up to March 1, 1923, and since 1911, there had been placed 745,000 sq. yd. of lining on 78.5 miles of canals and laterals on the project at an average cost of 38.9 cents per sq. yd. of lining and $3,690 per mile of canal and lateral. These costs have been incurred over a period of time during which labor and material costs have fluctuated greatly. Common labor has ranged from a minimum of $2.24 to a maximum of $4 per day of 8 hours, while other items entering into the cost have varied in about the same ratio.

The work of concrete lining as described in the foregoing article was performed under the general supervision of A. P. Davis, Director, U. S. Reclamation Service, and F. E. Weymouth, Chief Engineer, with the writer as engineer in field charge of operations.

A NORTH AMERICAN ROLLER ON THE JOB IN SOUTH AMERICA



MOVABLE STAGING FOR OVERHEAD WORK

Ingenuity of Construction Company Foreman Enables Workman to Proceed Without Frequent Stops to Move Platform

By G. W. Maker,
Aberthaw Construction Company.

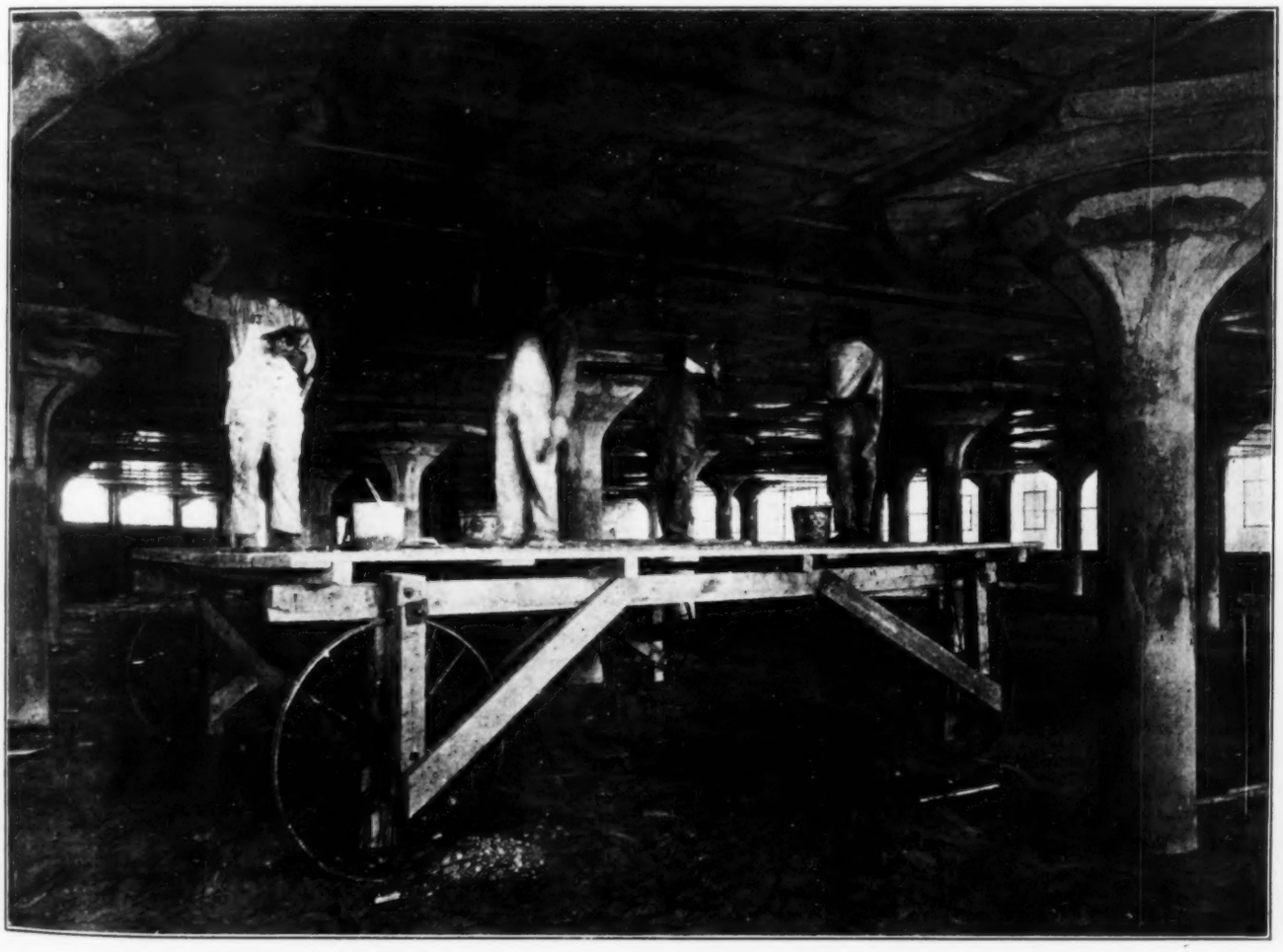
FOR work on ceilings, or other overhead work, the actual labor cost is usually increased appreciably through having to construct stagings or platforms from which to work, and also through the necessity for stopping work to move such platforms, particularly when only one or two men are using them, and help has to be called from other parts of the work to assist in the moving operation.

The Aberthaw Company of Boston has largely overcome this expense through the use of a movable staging. For overhead work it was formerly the practice to use large platforms. An ingenious labor foreman conceived the idea of placing wheels on one of these platforms and the result has been so satisfactory that the company has adopted the idea wherever overhead work is called for.

The accompanying photograph shows one of these mounted platforms in operation. While mobility is its chief feature, it should be particularly noted that the arrangement is roughly though substantially constructed at small cost from material usually available on a construction contract. The frame is made of joists formerly used for form lumber, while floor form panels are used for the top. The wheels have been borrowed temporarily from concrete buggies and are supported on old form bolts driven through the platform posts.

These platforms, though crude, move with surprising ease—in fact, moving is accomplished by the workmen pushing on the ceiling with their hands and often the wheel has to be chocked to keep the platform steady. The economy of this arrangement, which permits workmen to operate continuously without frequent stops to move stages, is obvious.

As the Aberthaw Company always has a large number of construction jobs under way in different cities the total saving by the adoption of a device like that shown is a considerable item.



PLATFORM MOUNTED ON WHEELS WHICH THE WORKMEN MOVE BY PUSHING ON THE CEILING

FRANK PAGE

Gentleman—Banker—Soldier—Road Builder

WHEN Frank Page was elected president of the American Road Builders' Association recently, many asked "Who is Frank Page?"

The situation is similar to that which arose in June, 1920, when the question flashed across the country, "Who is Harding?"

Both men had quietly been preparing for the big jobs which they were to undertake. Before the year is out the road builders of the country will find that the head of their national organization is a strong, courageous, well-trained man, who, as chairman of the North Carolina State Highway Commission, has put that State at the top of the list in highway progress.

FRANK PAGE

Frank Page was to the manor born. He comes from a family that has furnished notable men for generations. One of his brothers was the late Walter Hines Page, Ambassador to Great Britain during the war, and prior to that one of the leading publishers of this country. Another brother was in Congress for twenty years. A third brother is at the head of a chain of banks and trust companies in the South with which Frank Page himself is connected.

Other members of the family have achieved success in various other lines. Doing big things well, therefore, is a tradition in the Page family.

Not long after leaving college, Frank Page tackled the job of making a paying proposition out of a short-line railroad that was controlled by his family. He did this job so well that the line was sold to one of the trunk lines of which it is now an important link. Frank Page also had extensive experience in lumbering operations before he devoted practically all of his time to the banking business.

Soon after the war broke out Frank Page enlisted in the army, although he had two boys old enough to go and one of them died in service in France. Frank Page was offered a job getting out lumber in the West, but he felt that others could do that and asked to be sent right to the front. As a result, he was soon in France, where he saw service through much of the war as a major in charge of troop train operation. Those who were across know that such an assignment is not exactly a bomb-proof, swivel-chair job.

One incident of his military experience illustrates how loyal an organization can be to Frank Page. His regiment was outlawed for cause. In spite of the fact that nearly every man in the outfit had had his pay taken from him, the regiment gave Frank Page a silver service as their appreciation of his leadership of them.

After his return home Frank Page settled down to business again. Meanwhile the demand for better roads had become universal in North Carolina. The State had done some highway work, but there was little money and practically no organization available. Local politics also determined when and how most of the roads should be built. Log rolling was accepted as good practice by every politician in the State.

The time was ripe for the great change that occurred in highway affairs in North Carolina. The State Legislature passed a $50,000,000 bond issue, along with a law creating a State Highway Commission. That law has proved in practice to be the model that it was intended. It gave the State Highway Commission powers which had never before been conferred on any State organization. It made possible the removal of the highway affairs of the State from politics. But legislation could not make the man to execute successfully such a law.

Fortunately, about the time the North Carolina State Highway legislation was in the making, Frank Page was suggested to the Governor as the most logical man to be chairman of the commission. He had never been in politics and was known in his State solely as a business man. The Governor knew, however, that it was vital to put at the head of the commission a strong man who would administer the law courageously and fearlessly. He believed that Frank Page met the specifications. The record that Frank Page has made as chairman of the North Carolina State Highway Commission has fully justified the Governor's judgment.

When Frank Page undertook in 1920 to spend

$50,000,000 on highway work in North Carolina, the State had practically no organization. No local sources of sand, gravel and broken stone suitable for surfacing had been developed. Few contractors in that section of the South had ever built a modern road. A very limited mileage of second-class road had been constructed in the State. The State and the counties also had maintained partially a very small percentage of the highways of the State.

Working quietly in his determined way, Frank Page built, in a very few months, an organization that soon began to make highway history. One of his first moves was to induce C. M. Upham to leave Delaware to become State Highway Engineer of North Carolina. Frank Page soon saw that Upham could quickly and thoroughly organize the necessary engineering force and could handle the whole technical end of the job. He, therefore, devoted practically all of his time to the development of the administrative and executive organizations.

Teamed together, these two men have made records that are not yet appreciated outside of North Carolina and few adjacent States. They had 5000 miles of existing highway under regular, thorough, systematic maintenance within the first six months. By this move every part of the State quickly saw that the Commission could do things quickly, effectively and economically.

Meanwhile, new work was being started on a scale that scarcely seemed practicable, considering the previous lack of organization, of developed sources of materials and of experienced contractors. In 17 months nearly 2000 miles of road was placed under contract. In 1922 over 800 miles of road was completed. The estimate is that 1200 miles of new work will be built in North Carolina this year. Practically all of this mileage has required new locations, new structures and much heavy grading. Conditions varying all of the way from tropical swamps to some of the roughest mountains east of the Rocky Mountains had to be met.

Probably no better measure of what North Carolina thinks of the work of its State Highway Commission could be had than the action of the last legislature in approving an additional $15,000,000 appropriation for road work. More would have been furnished, but Frank Page said that was all that could be spent before the legislature would meet again.

How Frank Page gets things done has been variously estimated by different people who have seen different sides of him. He is primarily courageous and fearless. He is more than reasonable when dealing with a reasonable man but never runs away from a fight. He has no more respect for the political bosses of the State than he has for an ordinary citizen. He has acquired in some quarters a reputation for being somewhat of an autocrat. The general manager of one of the leading railroads that cross North Carolina when asked recently what he thought of Frank Page said: "Frank Page may have a reputation of being something of a czar, but he certainly does get things done."

Frank Page has one failing, if it is a failing, for a man in a public position of such importance as the one that he fills—he avoids publicity. He never has much to say about what he has done or what he intends to do. He will probably not say much about his program as president of the American Road Builders' Association. A year hence, however, his leadership will have left a permanent record of progress in making that organization what it should be as really representative of the highway builders of the country.

American Road Builders Elect Officers

ANNOUNCEMENT of the election of new officers and directors and decision by the new Board of Directors as to the time of the next convention and National Good Roads Show were the chief features of the annual meeting of the American Road Builders' Association held in New York May 15. Reports were received from the executive committee, the treasurer and the convention committee. The new officers and directors are:

President, Frank Page, Chairman, State Highway Commission, Raleigh, N. C. Vice-President, Northeastern Dist., E. L. Powers, Editor "Good Roads," New York City. Vice-President, Southern Dist., W. S. Keller, State Highway Engineer, Montgomery, Ala. Vice-President, Central Dist., S. F. Beatty, Vice-President, Austin-Western Road Machinery Co., Chicago, Ill. Vice-President, Western Dist., Samuel Hill, Hon. Life Pres., Washington State Good Roads Assn., Seattle, Wash. Treasurer, James H. MacDonald, Consulting Road and Paving Expert, New Haven, Conn.

Directors for One Year—J. R. Draney, Sales Mgr., U. S. Asphalt Refining Co., New York City. Frank T. Sheets, Supt. of Highways, Dept. of Pub. Wks. & Bldgs., Springfield, Ill. W. A. Van Duzer, Asst. Maint. Engr., State Highway Department, Harrisburg, Pa.

Directors for Two Years—C. M. Babcock, Commissioner of Highways, St. Paul, Minn. H. K. Bishop, Chief, Div. of Const., Bureau of Public Roads, Washington, D. C. H. S. Carpenter, Deputy Minister of Highways, Regina, Sask., Canada. J. H. Cranford, Pres., Cranford Paving Co., Washington, D. C. E. J. Mehren, Editor "Engineering News-Record," New York City. I. W. Patterson, Chief Engr., State Bd. of Public Roads, Providence, R. I. Wm. R. Smith, Pres., Lane Construction Corp., Meriden, Conn.

Directors for Three Years—Will P. Blair, Vice-President, National Paving Brick Mfrs. Assn., Cleveland, Ohio. R. Keith Compton, Chmn., Paving Commission, Baltimore, Md. S. T. Henry, Vice-Pres., Allied Machinery Co. of America, New York City. Fred A. Reimer, Engr., The Asphalt Assn., Newark, N. J. H. G. Shirley, Chmn., State Highway Commission, Richmond, Va. Frank Terrace, Pres., Washington State Good Roads Assn., Orillia, Wash. Chas. M. Upham, State Highway Engineer, Raleigh, N. C.

Following the close of the annual meeting, the new board of directors met, elected Ethel A. Birchland secretary pro tem, and an executive committee, consisting of Thomas J. Wasser, S. T. Henry and William R. Smith, with the president and the treasurer as members ex-officio.

The board then took under advisement arrangements for the next convention and National Good Roads Show. Chicago was selected as the place of meeting and Jan. 13 to 19, 1924, as the dates.

The sessions were concluded with a get-together dinner, at which the chief address, on results of the Connecticut traffic survey, was made by Thomas H. MacDonald, Chief of the Bureau of Public Roads.

NEBRASKA BUILDS DIRT ROADS

Smiley Canyon Highway Is Typical Example of This Type of Construction

By R. L. Cochran,
State Engineer.

FOR obvious reasons the State of Nebraska at the present time is making no attempt to build a great mileage of hard surfaced roads. The Nebraska Department of Public Works the last few years has wisely concentrated its attention on the construction of earth roads and a highway system consisting of roads which radiate from the various county seats has been laid out. Altogether about 2000 miles of earth roads have been constructed in Nebraska in the last few years and further construction work is being carried on as rapidly as possible.

BUILDING THE SMILEY CANYON ROAD

There seems to be no doubt that Nebraska has developed the earth road to a greater extent than almost any other State, and the photographs on these pages give a good idea of the sort of work the department is doing. Several of them show scenes on the Smiley Canyon road in the northwestern part of the State. This road passes through a section which is sparsely settled and where the topography is exceedingly rough and almost mountainous. Before the road was constructed there was a stretch of 20 miles between the towns of Crawford and Harrison where there was no road with the exception of two insufficient trails which followed White River and Soldier Creek. During the rainy season the bridges along these trails were continually destroyed and the trails themselves were washed out in numerous places making traffic impossible.

When it was decided to build this Smiley Canyon road two great difficulties were encountered, the leveling of the hills and the draining of the canyons. Smiley Canyon itself is 2 miles long and is crossed

A TYPICAL DIRT ROAD IN NEBRASKA

by three large bridges. In addition to the construction of these bridges, it was necessary to install a number of small culverts to take care of the water which came pouring into the canyon from the innumerable small draws which empty into it. The magnitude of the job is indicated by the fact that approximately 65,000 yd. of material were excavated in building the section through the canyon. Of this, 20,000 yd. were solid rock, and about 15 tons of explosives were used in blasting. One of the photographs shows one of the bigger blasts. The nature of the country was such that the average grade of the road is 7 per cent.

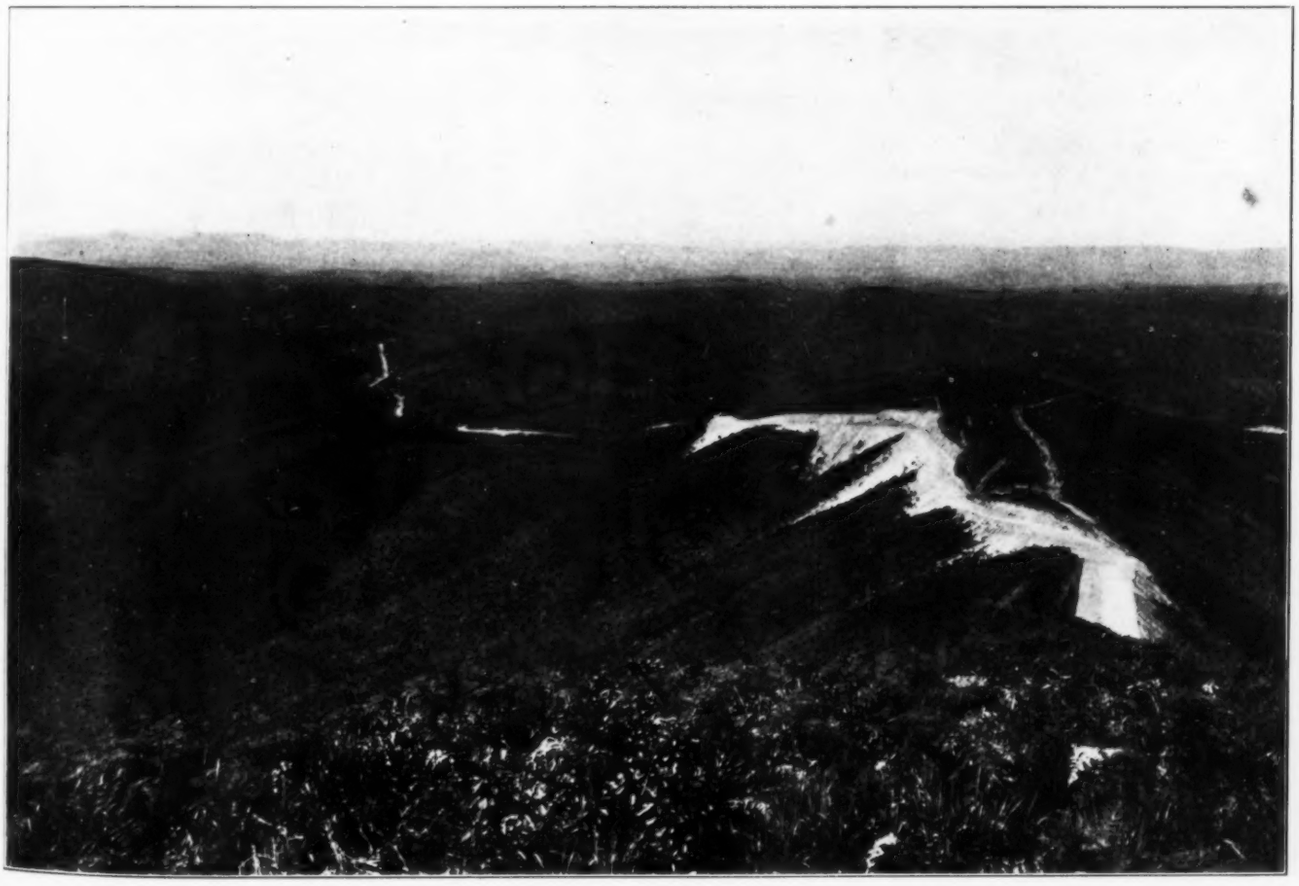
BLASTING DURING THE CONSTRUCTION OF THE SMILEY CANYON ROAD

The building of the Smiley Canyon road is an example of the cooperation of Nebraska with other States, as the road is of more importance to through travel than it is locally. It established a connecting link between three of the most-traveled Nebraska highways and the road which crosses the Nebraska line, connects with a road which leads to Cheyenne and heads toward Yellowstone Park.

The construction of such a great mileage of earth roads makes the maintenance problem exceedingly important and the State Highway Department has utilized its share of the surplus army equipment for this work. The trucks and tractors received from the Government are used to drag the roads and pull maintainers. The maintenance on the State highways begins as soon as they are constructed and each county has a patrol system which works under the supervision of the State department. In this way satisfactory and uniform results are obtained.

George E. Johnson, who has just retired after eight years of service as State engineer, had a major part in the laying out of the present State highway system. Before the present road building policy was adopted Mr. Johnson visited 22 different States and inspected their earth roads. The knowledge that he gained was put to good use in planning Nebraska's system.

AN EARTH ROAD IN BRAZIL



STEAM SHOVEL WORK ON CITY EXCAVATION

Costs Compared with Hand Labor at Present Prices

By Frank W. Skinner, Consulting Engineer

THE excavation for the 22-story Equitable Life Insurance Company's building, fronting on Seventh Avenue, Thirty-first and Thirty-second Streets, New York City, required the removal of about 100,000 yd. of material from a pit approximately 275 x 200 ft. and 50 ft. deep, located in a solidly built district.

It was necessary to complete the excavation safely and with the greatest rapidity without obstructing the heavy traffic in the streets on three sides of the lot. The Thomas Crimmins Contracting Company, therefore, installed four steam shovels, an adequate rock-drilling outfit, and a large fleet of motor trucks that handled the difficult work satisfactorily, operating much the same as an ordinary railroad grading or other deep, heavy excavation.

The lot was covered with about 40,000 yd. of earth, sand and fill from 1 to 30 ft. deep over the irregular sloping surface of the micaceous schist rock, which varied from hard to soft and rotten, and was found in thick and thin layers and large masses inclined at every angle. This added to the difficulty of the job.

The stripping of the earth was done wholly by steam shovels, of several makes, that entered the lot from street level, digging a slope parallel and adjacent to Seventh Avenue and excavating a 40 x 40-ft. horizontal space about 16 ft. below the curb at the foot of the slope, whence they radiated to different parts of the lot, covering the whole area with cuts about 17 ft. in maximum depth and repeating them until the surface of the rock was exposed and removed when loose or soft enough to be handled by the buckets without preliminary shattering.

The shovels loaded the earth and loose stones directly into a fleet of about fifty 5-ton motor trucks that entered the lot on the Seventh Avenue slope, from the foot of which they backed up to the shovels, received their loads of earth in from 1 to 4 min., and hauled them out of the pit without turning.

The movement of the trucks was well regulated, so that no congestion occurred, and there was very little

GENERAL VIEW OF EXCAVATION SHOWING FOUR STEAM SHOVELS AT WORK SERVED BY FLEET OF TRUCKS

THE SHOVEL IN THIS PHOTOGRAPH WAS CARRIED DOWN IN ADVANCE OF THE GENERAL EXCAVATION TO A DEPTH OF MORE THAN 50 FEET

waiting either by trucks or shovels. Support for the steam shovels with wide face wheels, and for the trucks was provided by 4-in. planks 14 ft. long, laid transversely on the slopes and on the bottom of the pit, and no difficulty was experienced with traction.

After the removal of the earth and loose or rotten rock, the surface of the solid rock from 1 to 30 ft. below curb level was drilled by about 14 jackhammer drills operated by air from four electrically-driven compressors installed in pairs on the street. The holes, of a maximum depth of about 10 ft., were loaded with light charges of dynamite (protected by heavy wire and manila rope mattresses and by chained timbers) and fired. The rock was shattered so that it could be handled by the shovels that loaded most of it into the trucks and into about 30 steel skips that in places not readily accessible to the shovels were operated by the long booms of derricks at street level, to load trucks in the street.

Neither the earth nor the rock excavation could be carried on over the entire area of the lot at first, because adjacent buildings, extending to the lot line on one side, had their footings in earth from 20 to 25 ft. above the rock and were underpinned by a heavy continuous reinforced concrete wall started at the cellar floor level and carried down in three successive sections or courses to the solid rock. The excavation alongside the wall, therefore, was deferred until the upper course was built, when it was carried down to the bottom of this course, the next course built, excavation continued, and the third course built and adjacent earth excavated down to the surface of the rock, after which the rock was drilled, blasted up to lot line and face of wall, and removed by the steam shovel.

A pit about 40 ft. across was carried down to subgrade in advance of the other excavation; it was started by hand, but as soon as it was large enough a steam shovel was installed in it and eventually a second shovel, that loaded the rock into skips because the pit was inaccessible to trucks. The shovels remained at low level, enlarging the pit until the excavation was completed.

Careful cost figures were kept and for one of the shovels the direct average expense of operation per 8-hr. shift loading 5-ton trucks was:

Wages of shovel runner	$10.60
Wages of helper	6.76
½ ton soft coal	5.00
1 gallon oil	1.00
Water	2.00
	$25.36

The general expenses for the shovel were:

1 yoke bolt for dipper handle	$ 1.25	
1 ⅝ x 86 ft. hoist cable	15.00	
1 set points for teeth	32.00	
	$48.25	

The cost of repairs was:

Cost of moving shovel 2 mi. and installing on job	$ 11.35	
Interest for 90 days on $7,570, value of shovel	113.54	
Depreciation, 6%	454.20	
General expense for 70.12 8-hr. shifts	$627.34	
General expense for 1 8-hr. shift	8.95	8.95
Total cost of operation for 1 48-hr. shift		$34.31

At this rate the cost of steam-shovel loading and excavating 127 loads equals 508 yd. of earth in 8 hr. was $34.31; equals $0.0675+ per yard, and for excavating and loading 44 loads equals 132 yd. of stone in 8 hr. was $34.31; equals $0.26 per yard.

The total cost of steam-shovel work for the entire job (which was not completed when these data were recorded, approved and verified) should therefore be estimated at:

40,000 yds. of earth excavation and loading at $0.0675 =	2,700
60,000 yds, of shattered rock loading at $0.26 =	15,600
Total cost of excavating and loading 100,000 yds. of earth and rock in deep city excavation	$18,300

The shovel in handling rock did the work of about 12 men and a derrick. In handling earth it replaced about 20 men digging and shoveling into the truck, or 15 men digging and shoveling into the skip or bucket on the ground handled by a derrick when the digging is easy. It also saved all drilling and blasting to shatter soft, loose rock and most kinds of hard earth.

If the steam-shovel work had been done by hand, with labor at $6 for 8 hr., as actually paid in New York Nov. 1, 1922, the cost would have been 20 x 6 = $120 per 8-hr. shift for earthwork which cost $34.31 by steam shovel = 3.49 times as much. The cost of the rock work, exclusive of cost of derrick service and increased cost of blasting and sledging, which would have been a material amount, would have been 15 x 6 = $90 for 8 hr. shift that would have cost $34.31 by steam shovel = 2.62 times as much.

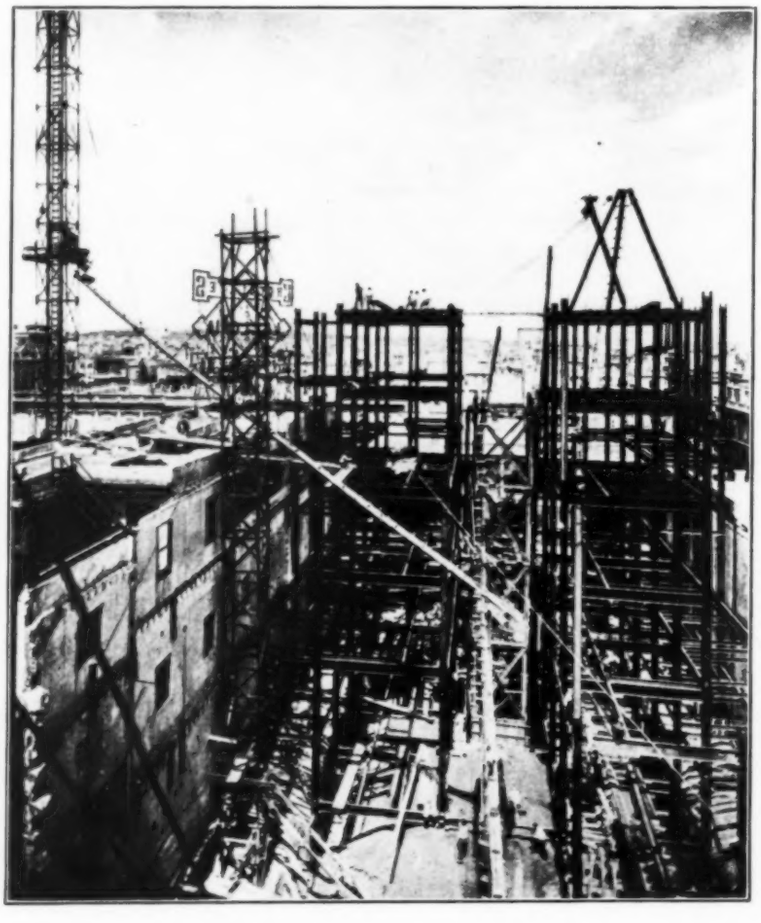
If the whole job had been done by hand instead of by steam shovel the cost would have been:

$ 2,700 x 3.49 = $ 9,323—cost of 40,000 yds. earth
15,600 x 2.62 = 40,872—cost of 60,000 yds. rock

Total cost of hand excavation and loading	$50,195	
Total cost of steam shovel excavation and loading	18,300	
Saving by use of steam shovels for 100,000 yds. excavation and loading	$31,895 = 174%	

HAVANA CONTRACTOR RENTS VACANT LOT FOR TOWER

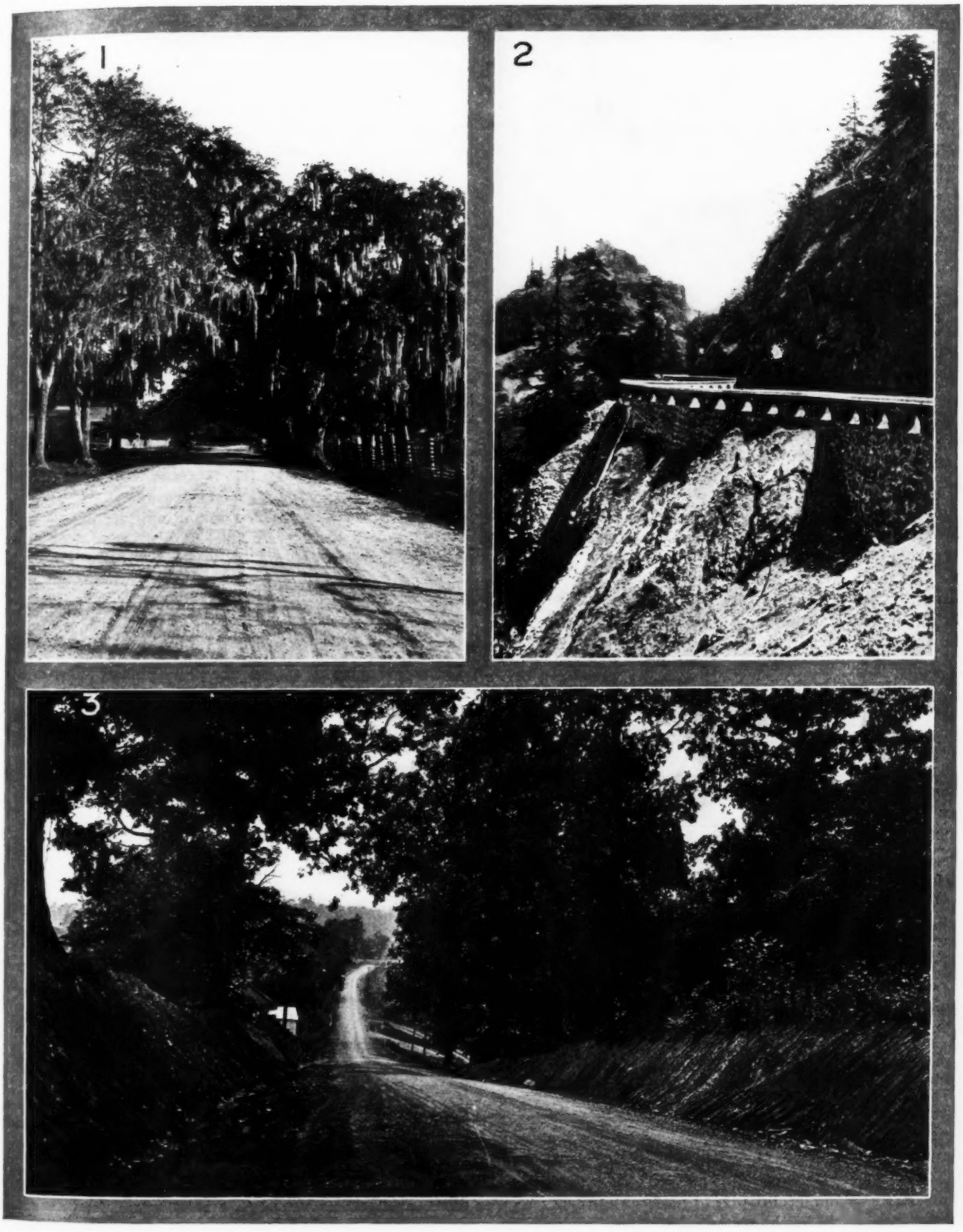
AN ingenious plan to overcome the handicap imposed by restricted space in a building operation has been devised by Arellano & Mendoza, contractors of Havana, Cuba. They are building an addition to the Hotel Sevilla-Biltmore and found that there was not room enough for the main chuting tower on the site of the work. They therefore rented a vacant lot, put up a chuting tower 165 ft. high and carried the chute from this tower across an intervening 3-story building. The photograph which accompanies this article shows this tower rising from the vacant lot at the left and the chuting extending across to the site of the new hotel.



All of the footings were poured from this plant and the work was conducted without delay. Arellano & Mendoza have done considerable work in Havana in the last few years with equipment bought in the United States. Much of the equipment in use on the present job is of American manufacture. Even the wheelbarrows and hand shovels were made in the United States.

The hotel is progressing in satisfactory fashion and is a good example of the kind of construction work that is being done by up-to-date contractors in Cuba who make full use of modern machinery.

Three Federal Aid Roads



1. A scene on Project No. 76, a sand clay gravel road at St. Tammany, La.
2. A section of Project No. 35. A bituminous concrete highway in Wasco County, Oregon.
3. A waterbound macadam road project No. 54 in Rockbridge County, Virginia.

Photographs from the U. S. Bureau of Public Roads

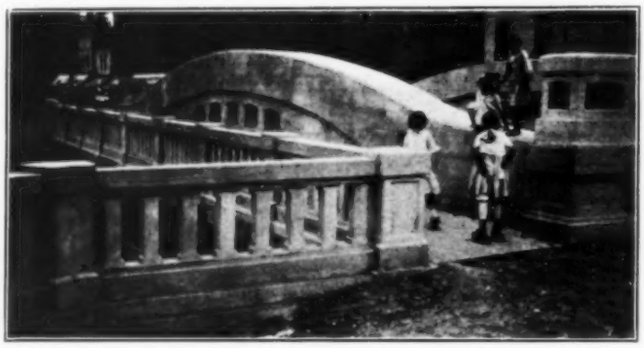
MICHIGAN FAVORS CONCRETE BRIDGES

Local Contractors Better Equipped to Handle Work Than Where Steel Structures Are Used

By F. D. Messenger, Contract Engineer,
Michigan State Highway Dept.

THE Michigan State Highway Department has concentrated to a large extent on the reinforced concrete girder type of structure for bridges constructed under the direction of the department, as this type of structure more nearly fits Michigan conditions and is more economical at the present time than other types. Our bridge department, under the direction of C. A. Melick, bridge engineer, has gone beyond the usual limiting spans in the design of concrete girders. In 1920 Mr. Melick began designs for structures of this type up to spans of 90 ft., and since that time contracts have been awarded by this department for fifteen bridges of this type and span, of which seven have been completed to date. During the last two years, since Jan. 1, 1921, the State Highway Commissioner has awarded contracts for 108 bridges of more than 30 ft. clear span, of which 89 are concrete girders.

No. 1—A 75-FT. GIRDER BRIDGE OVER BEAR CREEK NEAR HUDSON

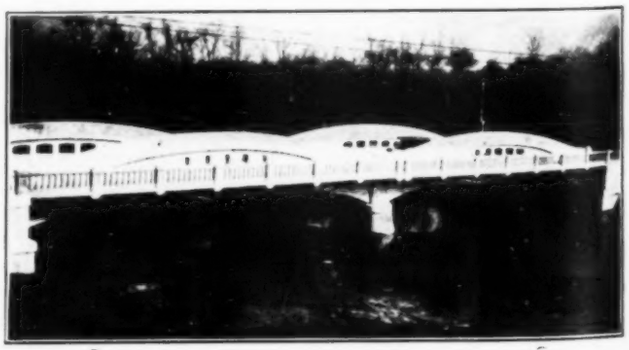


No. 2—THIS BRIDGE CROSSES THE SEBEWAING RIVER IN HURON COUNTY

In considering types of proposed bridge structures in this State, the relative abundance of good concrete gravel is of prime importance. Our specifications provide for separated aggregates and a content of not more than 3 per cent of clay. This means that all gravel has to be screened, but many gravel pits are available where the gravel will meet the clay content specifications without being washed. Gravel may be purchased in the pit at from 10 cents to 25 cents per cubic yard, while washed, screened gravel may be secured from commercial plants at from 60 cents to 80 cents per ton. With cement furnished under State contract at $2.10 to $2.20 per barrel, the concrete price, including the reinforcing steel, for reinforced concrete superstructures is running $25 to $35 per cubic yard under normal conditions.

A 90-ft. through concrete girder with 20-ft. roadway contains about 255 cu. yd. of concrete, which gives an average cost of about $8,000 for this type of superstructure. In comparison, a 90 x 20 ft. steel truss contains about 120,000 lb. of steel, and with a present price of around 7½ cents per pound erected, we have $9,000 for the steel. A reinforced concrete floor for this type of structure will run about $1,500, giving a total first cost of $10,500 for a steel truss as against $8,000 for a reinforced concrete girder. There is a further difference in cost between these two types in view of the difference in size of abutments. The top 8 ft. on an abutment for a steel truss is included in the superstructure for a 90-ft. concrete girder. The difference in maintenance cost between the two types of structures is obvious.

There are other marked advantages of a concrete girder over a steel structure. On a concrete bridge one contractor handles both the substructure and superstructure, and there are a considerable number of contractors in Michigan with equipment and experience to handle the work. On steel structures there must be separate contracts for concrete work and for steel superstructure, and there are only a few fabricating companies equipped to erect according to our specifications. Then, after the sub-contractor is out of the way and the steel is erected, there remains the



No. 3—A DOUBLE SPAN ACROSS THE PAW PAW RIVER IN BERRIEN COUNTY

placing of the concrete floor, which is always an expensive job because the yardage of concrete is so small. Also, in these days of uncertainty in delivery of construction materials, it is worthy of note that reinforcing steel can be secured with little difficulty, while delivery of structural steel is uncertain.

Materials for a concrete structure may be transported over poor roads to bridge locations without a great deal of difficulty, but the same cannot be said of structural steel. In the design itself, there is a much greater factor of safety in the concrete structure, as the dead load is so large that an unusual live load will not greatly increase the stresses, while on a steel structure an unusual live load might stress the steel beyond the elastic limit.

In considering through concrete girders of greater span than 90 ft., the relative difference in first cost between concrete and steel superstructures is negligent for spans of 100 and 110 ft. Maintenance cost and aesthetic considerations apply, of course, to all span lengths. The department is planning on designs of concrete girders to include structures of 100, 110 and 120 ft. spans.

A few brief comments on the accompanying photographs follow:

No. 1.—This structure is a 75-ft. concrete girder with 20-ft. roadway, and has an angle of 60 deg. with the stream. There are 232 cu. yd. of concrete in the

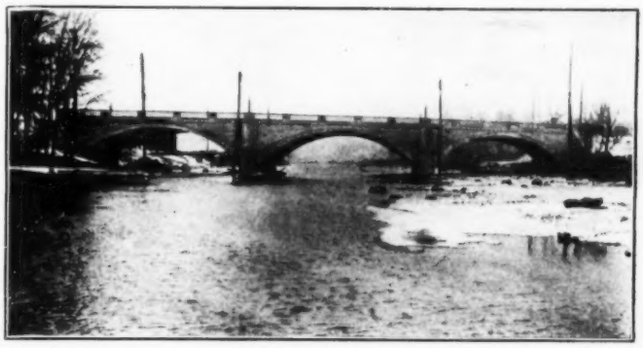
No. 4—A 90-FT. GIRDER. THIS BRIDGE CROSSES THE RAISIN RIVER AT TECUMSEH

abutments and 200 cu. yd. in the superstructure. The contract was awarded in June, 1921, and was completed in September, 1922, at a total cost of $13,850. This cost includes $519 for removing the old bridge and for maintaining a temporary structure as a detour.

No. 2.—This structure, which was awarded in November, 1921, is a 75-ft. concrete girder with 24-ft. clear roadway and two 6-ft. cantilever walks, and contains a total of 731 cu. yd. of concrete. This contract was completed in November, 1922, at a cost, exclusive of lighting, of $13,200, which sum includes $400 for removing the old bridge and maintaining a temporary structure during construction.

No. 3.—This structure comprises two 75-ft. concrete girders with 18-ft. clear roadway and one 5-ft. walk. It is placed at an angle of crossing of 45 deg. The contract was awarded in January, 1922, and includes 424 cu. yd. of concrete in the substructure and 442 cu. yd. in the superstructure. The bridge was completed in November, 1922, at a total cost of $28,829, which includes $366 for removing the old bridge and $4000 for placing 5000 lin. ft. of piling.

No. 4.—This structure is of particular note in view of the span, as it is a 90-ft. concrete girder. The clear roadway is 20 ft. and provision is made for the later addition of two 5-ft. walks. The angle of crossing is 50 deg. The contract was awarded in May, 1921, and includes 310 cu. yd. of concrete in the substructure and 328 cu. yd. in the superstructure. The



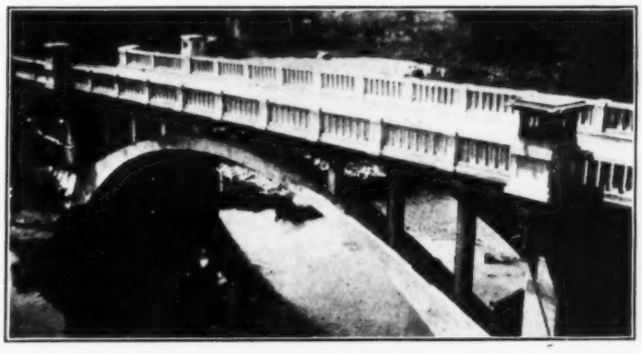
No. 5—THREE ARCHES ARE NEEDED TO CROSS THE CLINTON RIVER AT MT. CLEMENS

contract was completed, except for clean up, in December, 1921, at a cost of $21,450. This price includes $1,336 for special drainage work.

No. 5.—This is one of the older arch designs. The contract was awarded in June, 1919, and there are two 70-ft. and one 75-ft. concrete arches at an angle of crossing of 70 deg. The overall width is 60 ft. 6 in., and the structure contains 3754 cu. yd. of concrete. The construction was completed in September, 1920, at a total cost of $96,728. This cost includes $3000 for removing the old bridge and maintaining a temporary foot bridge and $1,941 for a concrete retaining wall.

No. 6.—This is one of the later designs of concrete arches and is a 100-ft. arch with a 24-ft. roadway, involving 1127 cu. yd. of concrete. The contract was awarded in July, 1921, and completed in July, 1922, at a total cost of $49,265. This total cost includes $350 for removing the old bridge and $14,895 for piling and special foundation work.

These structures were designed and constructed



No. 6—A 100-FT. CONCRETE ARCH OVER THE THORNAPPLE RIVER AT HASTINGS

under the general supervision of Frank F. Rogers, State Highway Commissioner, with C. A. Melick, Bridge Engineer, directly responsible for the design.

SHOVEL DIGS SEWER TRENCH

Efficient Methods Used on Difficult Job

A DOUBLE-DECK sewer, 2½ miles long, is just being finished in Maple Heights, Ohio, a suburb of Cleveland, by the Haddad-Mall Company of Cleveland. The photographs on this page show the methods and machines used for this job. Practically all of the excavation has been done with the two rigs shown. One of them is a 1-yd. shovel with a special trenching stick and dipper, and the other a crane handling a ¾-yd. clamshell bucket. At times another trench rig has been used, as well as a backfiller.

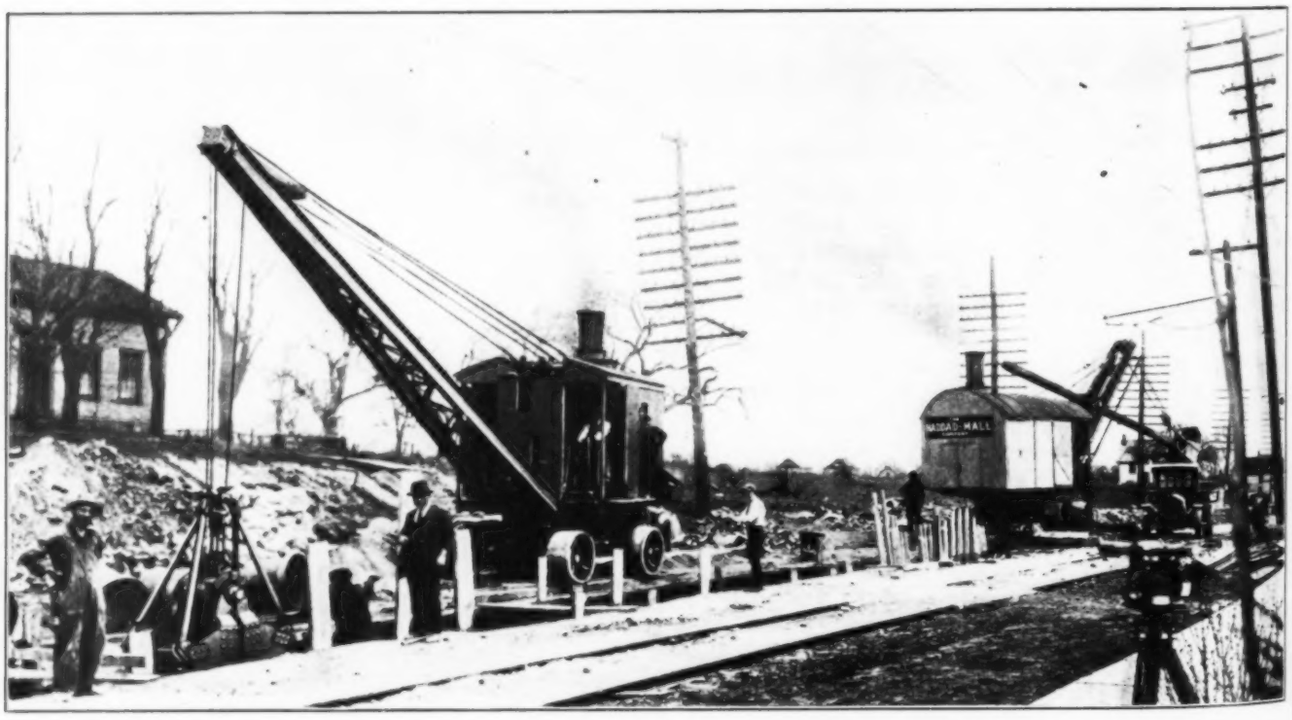
DOWN IN THE TRENCH. THE CLAMSHELL BUCKET MAY BE SEEN IN THE BACKGROUND

Most of the road lies along a hillside, and in addition the trench had to be dug close to an interurban trolley track. In order to hold the grade for the sewer line it was necessary to go as deep as 30 ft. in some places. About 21 ft. is a fair average. The excavation was started with the shovel digging to a depth of 12 to 15 ft. and bringing the dipper right through the pavement as it was moved ahead. The clamshell rig followed and kept it digging to grade. The earth in this locality is hard blue clay. The road has been paved so many times that the surfacing through which the shovel had to cut its way was a mixture of macadam, brick, concrete and asphalt.

The first line of sewer was the sanitary sewer, for which standard sewer pipe was used. Above this is a brick storm sewer. The lower pipe line varies from 8 to 24 in. inside diameter and the upper from 32 to 50¾ vertical diameter and 24¼ to 40 in. horizontal diameter, making it egg-shaped.

Much of the work was done under extremely bad weather conditions and an unexpected snow and windstorm created considerable trouble. One storm late in the spring blew down telegraph poles, one of which missed the shovel by inches. In addition it became necessary in one place to cut through a culvert. This in turn necessitated the setting up of pumping rigs which had to be kept going continuously in order to keep the water out of the trench.

The engineer in charge is C. W. Courtney of Cleveland, and Alex and Saed Haddad, members of the construction company, have been on the job ever since the work of excavation began.



THE CLAMSHELL RIG AT THE LEFT AND THE SHOVEL WORKING AHEAD AT THE RIGHT

RAISING A HEAVY TANK

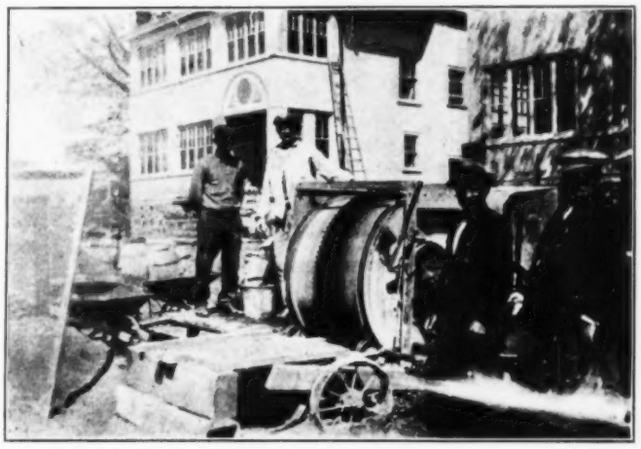
WHEN it became necessary to increase the height of a 60-ton water tank, the F. M. Sibley Lumber Company decided to raise the whole structure and slip in the desired 25 ft. A frame constructed of

four heavy 14 in. by 14 in. by 40 ft. timbers, one on each corner and fastened at the top by 4 x 8 in. pieces were erected around the tank. Two heavy chain falls were chained to these cross pieces at opposite corners. Cable tackles and winches were used on the other two corners. The cable was then fastened to each corner of the supporting uprights. Six guy wires were attached to the bottom of the water tank, each having a tackle block, and as the tank was raised these guy wires were manipulated and held the structure steady.

When raised the 25 ft., the new section was slipped in on the old foundation and joined to the bottom of the steel frame. The new section measures 24 ft. by 24 ft. square at the top and bottom. The tank stands 100 ft. high. The job was accomplished in less than a week without a mishap or accident.

MIXER LIVES UP TO NAME

THE mixer shown in the photograph which accompanies this article is owned by Zibelli Bros. of Mount Vernon, N. Y., who are building a number of dwelling houses, two of which are shown in the background. This mixer has proved a sort of universal tool as it has been used for mixing the concrete for the foundation, the stone mortar for the pavement, the



plaster for the inside walls and the stucco for the outside walls.

It took some experimenting to obtain these results, John Zibelli, who is shown on the charging platform of the mixer, being the chief experimenter. He found that by putting a couple of barrels of water in the mixers before putting in his dry aggregates, he had no trouble in cleaning it out and changing from concrete to stucco or vice versa.

MILLIONS FOR MAINTENANCE

The Pennsylvania Highway Department is planning to spend $56,200,000 in the next two years or at the rate of more than $28,000,000 a year for the necessary road maintenance work. Paul D. Wright, State Highway Commissioner, has issued the following statement in regard to the importance of maintenance:

"It is the policy of the department, under the present administration, to give business-like consideration to the maintenance feature of its work, with the belief that whether or not there is money for construction work the roads should be given a character of maintenance that will properly preserve hard-surfaced highways and put earth roads in as travelable condition as their character will permit."

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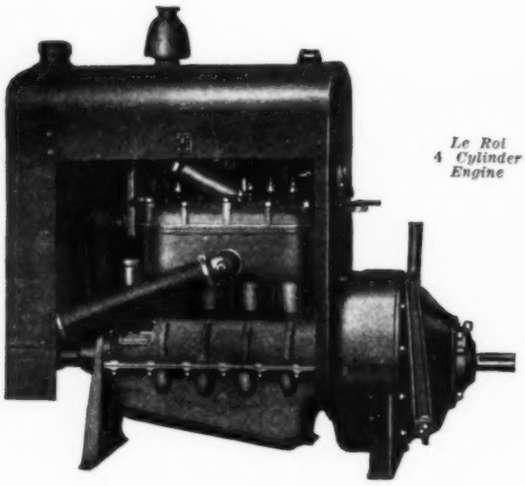

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Where you find a manufacturer using Williamsport Wire Rope as standard equipment you may feel assured this manufacturer wants you to have the best equipment that money can buy and he wants you to KNOW you are getting it.

Williamsport is the only wire rope made, the grade of which can be identified without a laboratory test. Why take a chance with unmarked ropes on hazardous operations? Send for our interesting booklet MWR, which every wire rope user should have, also names of crane, shovel and derrick manufacturers using Williamsport Wire Rope.

WILLIAMSPORT WIRE ROPE COMPANY

Main Office and Works
Williamsport, Penna.

Gen'l Sales Office
Peoples Gas Bldg.

Engineering Service To Buyers For Export

MANY of the manufacturers of engineering machinery whose announcements appear in this publication handle their export business through a common department—the Allied Machinery Company of America.

The Allied Machinery Company of America maintains branch offices and connections throughout the world at the addresses given below.

At each address there are located engineers capable of advising in regard to the most modern American construction and material-handling methods and machinery.

This advisory engineering service is at your disposal. It is supplemented by an organization thoroughly experienced in shipping heavy machinery to all parts of the world.

Allied Machinery Company of America

Cable Address: ALMACOA

51 CHAMBERS STREET—NEW YORK

BRANCH OFFICES:

ARGENTINA—Buenos Aires, Av. de Mayo 1035. Cable Address: ALMACOA.

BELGIUM—Brussels Allied Machinery Company of America, Rue de la Montagne 52. Cable Address: ALMACOA.

CHILE—Santiago, Allied Machinery Company of America, Edificio Ariztia, Calle New York, Esquina de la Bolsa, Piso No. 9. Cable Address: ALMACOA.

CHINA—Shanghai, Allied Machinery Company of America, 15 Foochow Road. Cable Address: ALMACOA.

CUBA—Havana, Allied Machinery Company of America, Obrapia 23. Cable Address: ALMACOA.

ENGLAND—London, Allied Machinery Company, Limited, 70 Victoria St., S. W. 1. Cable Address: ALYDMACHIN.

FEDERATED MALAY STATES—STRAITS SETTLEMENTS and SIAM—United Engineers, Ltd., P. O. Box 613, Singapore. Cable Address: UNITEERS.

FRANCE—Paris, Allied Machinery Company de France, 19 Rue de Rocroy. Cable Address: ALMACOA.

ITALY—Turin, Allied Machinery Company d'Italia. Corso Dante 40. Cable Address: ALMACOA.

JAPAN—Tokyo, Horne Company, Ltd., 6-7 Takiyama-Cho Kyobashi-Ku. Cable Address: HORNE.

MEXICO—Mexico City, D. F. Joaquin M. de Uriarte 3a Palma 34. Cable Address: ALMACOA.

PERU—Lima, Allied Machinery Company of America. Calle Filipinas 559. Cable address: ALMACOA.

PORTO RICO—San Juan, Earl K. Burton, Inc., P. O. Box 1367. Cable Address: EKBURT.

PORTUGAL—Lisbon, Monteiro Gomes Ltda. Rua de Alecrim. Cable Address: TRACTORES.

SPAIN—Barcelona, Allied Machinery Company, S. A. E., Consejo de Ciento 318. Cable Address: ALMACOA.

SWITZERLAND—Zurich, Allied Machinery Company of America, Loewenstrasse 16. Cable Address: ALMACOA.

TRINIDAD—Port of Spain, Hardware and Electric Supplies, Ltd., 4 Frederick S. C. Cable Address: HARDWARES.

Joint Sales Service In New York City Territory

THE Allied Machinery Company of America manages the sales in New York City and vicinity of the following companies:

CLYDE IRON WORKS SALES COMPANY
Duluth, Minn.

AUSTIN-WESTERN ROAD MACHINERY CO.
Chicago, Ill.

AUSTIN MANUFACTURING COMPANY
Chicago, Ill.

THE LAKEWOOD ENGINEERING COMPANY
Cleveland, Ohio

THE UNIVERSAL CRANE COMPANY
Elyria, Ohio

The Allied Machinery Company follows in domestic business the same methods which it has used in building up all over the world the business of these and other important American manufacturers of construction machinery and equipment.

Men from the factories of the above manufacturers are resident in New York City to give customers expert service.

Stocks of the machinery and equipment made by these manufacturers are maintained in New York City to insure prompt deliveries. Repairs also are carried in stock so that customers may obtain immediate replacements.

Offices are at the Allied Construction Machinery Centre, 139-149 Centre St., New York City, where these manufacturers and several others have for some years maintained the largest permanent exhibit of this kind of machinery and equipment ever undertaken.

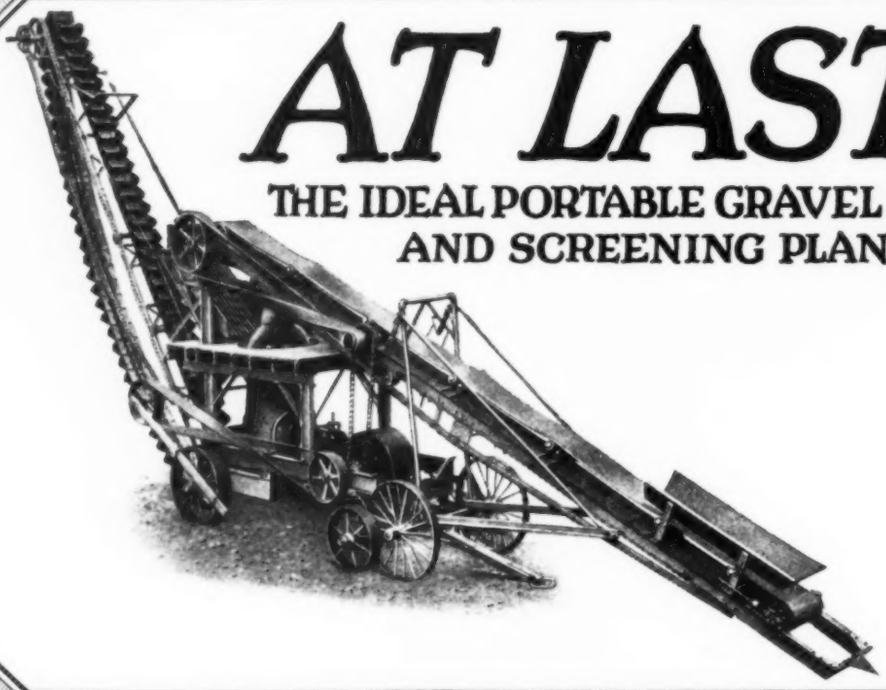
Allied Machinery Company of America

Domestic Sales Offices

139-149 CENTRE STREET, NEW YORK CITY

AT LAST!

THE IDEAL PORTABLE GRAVEL CRUSHING AND SCREENING PLANT



GRAVEL is brought from the pit in wagons, drags or fresnos, and dumped through a trap directly upon the conveyor, which in turn deposits the material upon a grizzly screen. The undersized material drops through the bars of the grizzly upon a chute leading directly to the elevator, while the oversize rolls down the bars into the crusher.

Nos. 2, 3 and 4 Austin Gyratory Crushers can be mounted on trucks and furnished with rigid or folding elevators of the required lengths, and gravel conveyors ranging in length from 30 feet to 50 feet. Optional equipment includes a revolving screen mounted on a portable bin.

While moving from place to place, the elevator folds down over the crusher; the conveyor is disconnected from the crusher, and its lower end attached to a truck or wagon.

A special bulletin describing these portable plants in detail is just off the press. We would like to send you a copy. Ask for Portable Gyratory Crusher Bulletin "X"

AUSTIN MANUFACTURING CO.

New York · CHICAGO · San Francisco